



STATE OF WASHINGTON

## STATE BUILDING CODE COUNCIL

### Washington State Energy Code Development Standard Energy Code Proposal Form

Jan 2022

Log No. 21-GP3-035

Code being amended:  Commercial Provisions  Residential Provisions

Code Section # **R403.5.6, R403.5.7, R403.13, R405.2(1), R406**

Brief Description: **This proposal updates Section R406 and requires additional energy efficiency credits. It is based on a prescriptive code which does not include heat pump mandates for space and water heating.**

Proposed code change text: (Copy the existing text from the Integrated Draft, linked above, and then use underline for new text and ~~strikeout~~ for text to be deleted.)

**R403.5.6 ~~Electric~~ Water heater insulation.** All ~~electric-tank-type~~ water heaters in unconditioned spaces, or on concrete floors in conditioned spaces, shall be placed on an insulated surface with a minimum thermal resistance of R-10, and a minimum compressive strength of 40 psi or engineered to support the appliance.

~~**R403.5.7 Heat pump water heating.** Service hot water in one and two family dwellings and multiple single family dwellings (townhouses) shall be provided by a heat pump system. The heat pump water heating system shall be sized to provide 100 percent of peak hot water demand. Where the heat pump is located in unconditioned space, the heat pump water heating system shall be sized to provide 100 percent of peak hot water demand at an entering source dry bulb (or wet bulb if rated for wet bulb temperatures) air temperature of 40°F (4°C).~~

**Exceptions:**

- ~~1. Resistance heating elements integrated into heat pump equipment.~~
- ~~2. Electric water heaters with a rated water storage volume of no greater than 20 gallons.~~
- ~~3. Dwelling units with no more than 1,000 square feet of conditioned floor area.~~
- ~~4. Supplementary water heating systems in accordance with Section R403.5.7.1, provided the system capacity does not exceed the capacity of the heat pump water heating system.~~
- ~~5. Solar water heating systems.~~
- ~~6. Waste heat and energy recovery systems.~~
- ~~7. Heat trace freeze protection systems.~~
- ~~8. Snow and ice melt systems.~~

**R403.5.7.1 Supplementary heat for heat pump water heating systems.** Heat pumps used for water heating and having supplementary water heating equipment shall have controls that limit supplementary water heating equipment operation to only those times when one of the following applies:

1. The heat pump water heater cannot meet hot water demand.
2. For heat pumps located in unconditioned space, the outside air temperature is below 40°F (4°C).

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3. The heat pump is operating in defrost mode.
4. The vapor compression cycle malfunctions or loses power.

**Exception:** Heat trace temperature maintenance systems, provided the system capacity does not exceed the capacity of the heat pump water heating system

**R403.13 Heat pump space heating.** ~~Space heating shall be provided by a heat pump system.~~

**Exceptions:**

- ~~1. Detached one- and two-family dwellings and multiple single-family dwellings (townhouses up to three stories in height above grade having an installed HVAC heating capacity no greater than 1.5 watts of electric resistance heating per square foot of dwelling unit conditioned floor area, or up to 500 watts, whichever is greater.~~
- ~~2. Group R-2 dwelling or sleeping units having an installed HVAC heating capacity no greater than 750 watts in Climate Zone 4, and 1,000 watts in Climate Zone 5, in any separate habitable room with exterior fenestration are permitted to be heated using electric resistance appliances. For buildings in location with exterior design conditions below 4°F (-15.6°C), an additional 250 watts above that allowed for Climate Zone 5 is permitted.~~
  - ~~2.1. A room within a dwelling or sleeping unit that has two primary walls facing different cardinal directions, each with exterior fenestration, is permitted to have an installed HVAC heating capacity no greater than 1,000 watts in Climate Zone 4, and 1,300 watts in Climate Zone 5. Bay windows and other minor offsets are not considered primary walls. For buildings in location with exterior design conditions below 4°F (-15.6°C), an additional 250 watts above that allowed for Climate Zone 5 is permitted.~~
- ~~3. Resistance heating elements integrated into heat pump equipment.~~
- ~~4. Solar thermal systems.~~
- ~~5. Waste heat, radiant heat exchanger, and energy recovery systems.~~
- ~~6. Supplementary heat in accordance with Section R403.1.2.~~
- ~~7. Where there is no electric utility service available at the building site.~~
- ~~8. Heating systems that rely primarily on biomass are allowed in Climate Zone 5.~~

**TABLE R405.2(1)**

**MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD**

Section	Title	Comments
<b>General</b>		
R401.3	Certificate	
<b>Envelope</b>		
R402.1.1	Vapor retarder	
R402.2.3	Eave baffle	
R402.2.4.1	Access hatches and doors	
R402.2.10.1	Crawlspace wall insulation installations	
R402.4	Air leakage	
R402.5	Maximum fenestration U-factor	
<b>Systems</b>		
R403.1	Controls	
R403.3	Ducts	Except for R403.3.2 and R403.3.3
R403.4	Mechanical system piping insulation	
R403.5.1	Heated water circulation and temperature maintenance system	
R403.5.3	Drain water heat recovery units	

Section <sup>a</sup>	Title	Comments
<del>R403.5.7</del>	<del>Heat pump water heating</del>	
R403.6	Mechanical ventilation	
R403.7	Equipment sizing and efficiency rating	
R403.8	Systems serving multiple dwelling units	
R403.9	Snow melt system controls	
R403.10	Energy consumption of pools and spas	
R403.11	Portable spas	
R403.12	Residential pools and permanent residential spas	
<del>R403.13</del>	<del>Heat pump space heating</del>	
<b>Electrical Power and Lighting</b>		
R404.1	Lighting equipment	
R404.2	Interior lighting controls	

a. Reference to a code section includes all the relative subsections except as indicated in the table.

## SECTION R406

### ADDITIONAL ENERGY EFFICIENCY REQUIREMENTS

**R406.1 Scope.** This section establishes additional energy efficiency requirements for all new construction covered by this code, including additions subject to Section R502 and change of occupancy or use subject to Section R505 unless specifically exempted in Section R406. Credit from both Sections R406.2 and R406.3 are required.

**R406.2 Carbon emission equalization.** This section establishes a base equalization between fuels used to define the equivalent carbon emissions of the options specified. The permit shall define the base fuel selection to be used and the points specified in Table R406.2 shall be used to modify the requirements in Section R406.3.

**TABLE R406.2  
FUEL NORMALIZATION ENERGY EQUALIZATION CREDITS**

System Type	Description of Primary Heating Source	Credits	
		All Other	Group R-2 <sup>a</sup>
1	For combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(5) or C403.3.2(6)	<del>-3.0</del> 0	0
2	For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(2) and supplemental heating provided by electric resistance or a combustion furnace meeting minimum standards listed in Table C403.3.2(5) <sup>b</sup>	<del>0</del> 1.5	0
3	For heating system based on electric resistance only (either forced air or Zonal)	<del>-1.0</del> 0.5	-0.5
4 <sup>c</sup>	For heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(2) or C403.3.2(9) or Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590	1.5 <del>3.0</del>	2.0
5	For heating system based on electric resistance with: 1. Inverter-driven ductless mini-split heat pump system installed in the largest zone in the dwelling, or 2. With 2kW or less total installed heating capacity per dwelling	0.5 <del>2.0</del>	0

- a. See Section R401.1 and residential building in Section R202 for Group R-2 scope.
- b. The gas back-up furnace will operate as fan-only when the heat pump is operating. The heat pump shall operate at all temperatures above 38°F (3.3°C) (or lower). Below that “changeover” temperature, the heat pump would not operate to provide space heating. The gas furnace provides heating below 38°F (3.3°C) (or lower).
- c. Additional points for the HVAC system are included in Table R406.3.

**R406.3 Additional energy efficiency requirements.** Each dwelling unit in a residential building shall comply with sufficient options from Tables R406.2 and R406.3 so as to achieve the following minimum number of credits:

- 1. Small Dwelling Unit: ..... ~~2.5~~ 5.0 credits  
Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet of fenestration area. Additions to existing building greater than 500 square feet of heated floor area but less than 1500 square feet.
- 2. Medium Dwelling Unit: ..... ~~5.0~~ 8.0 credits  
All dwelling units that are not included in #1, #3 or #4.
- 3. Large Dwelling Unit: ..... ~~6.0~~ 9.0 credits  
Dwelling units exceeding 5000 square feet of conditioned floor area.
- 4. Dwelling units serving R-2 occupancies: ..... ~~4.5~~ 6.5 credits  
See Section R401.1 and residential building in Section R202 for Group R-2 scope.
- 5. Additions 150 square feet to 500 square feet: ..... 2.0 credits

The drawings included with the building permit application shall identify which options have been selected and the point value of each option, regardless of whether separate mechanical, plumbing, electrical, or other permits are utilized for the project.

**TABLE R406.3  
ENERGY CREDITS**

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 <sup>b</sup>
<b>1. EFFICIENT BUILDING ENVELOPE OPTIONS</b>			
Only one option from Items 1.1 through 1.4 may be selected in this category. Compliance with the conductive UA targets is demonstrated using Section-R402.1.5, Total UA alternative, where $[1-(\text{Proposed UA}/\text{Target UA})] >$ the required %UA reduction			
1.1	Prescriptive compliance is based on Table R402.1.3 with the following modifications: Vertical fenestration U = 0.22.	0.5	0.5
1.2	Prescriptive compliance is based on Table R402.1.3 with the following modifications: Vertical fenestration U = 0.25 Floor R-38 Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab <b>or</b> Compliance based on Section R402.1.5: Reduce the Total conductive UA by 15%.	<del>0.5</del> <u>1.0</u>	1.0

1.3	<p>Prescriptive compliance is based on Table R402.1.3 with the following modifications:  Vertical fenestration U = <u>0.18</u>  Ceiling and single-rafter or joist-vaulted R-<u>60</u> advanced  Wood frame wall R-21 int plus R-12 ci  Floor R-38  Basement wall R-21 int plus R-12 ci  Slab on grade R-10 perimeter and under entire slab  Below grade slab R-10 perimeter and under entire slab  <b>or</b>  Compliance based on Section R402.1.5: Reduce the Total conductive UA by 22.5%.</p>	<del>1.0</del> <u>1.5</u>	1.5
1.4	<p>Prescriptive compliance is based on Table R402.1.3 with the following modifications:  Vertical fenestration U = 0.18  Ceiling and single-rafter or joist-vaulted R-60 advanced  Wood frame wall R-21 int plus R-16 ci  Floor R-48  Basement wall R-21 int plus R-16 ci  Slab on grade R-20 perimeter and under entire slab  Below grade slab R-20 perimeter and under entire slab  <b>or</b>  Compliance based on Section R402.1.5: Reduce the Total conductive UA by 30%.</p>	<del>1.5</del> <u>2.5</u>	2.0
<b>2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS</b> Only one option from Items 2.1 through 2.3 may be selected in this category.			
2.1	<p>Compliance based on Section R402.4.1.2:  Reduce the tested air leakage to 2.0 air changes per hour maximum at 50 Pascals, <b>or for</b> R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.25 cfm/ft<sup>2</sup> maximum at 50 Pascals  <b>and</b>  All whole house ventilation requirements as determined by Section M1505.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.65.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.</p>	<del>0.5</del> <u>1.0</u>	1.0
2.2	<p>Compliance based on Section R402.4.1.2:  Reduce the tested air leakage to 1.5 air changes per hour maximum at 50 Pascals, <b>or for</b> R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.20 cfm/ft<sup>2</sup> maximum at 50 Pascals  <b>and</b>  All whole house ventilation requirements as determined by Section M1505.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.75.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.</p>	<del>1.0</del> <u>1.5</u>	1.5

**TABLE R406.3 (continued)  
ENERGY CREDITS**

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 <sup>b</sup>
2.3	<p>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.6 air changes per hour maximum at 50 Pascals, <b>or</b> for R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.15 cfm/ft<sup>2</sup> maximum at 50 Pascals</p> <p><b>and</b></p> <p>All whole house ventilation requirements as determined by Section M1505.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.80. Duct installation shall comply with Section R403.3.7.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.</p>	<del>1.5</del> 2.0	2.0

**TABLE R406.3 (continued)  
ENERGY CREDITS**

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 <sup>b</sup>
<b>3. HIGH EFFICIENCY HVAC EQUIPMENT OPTIONS</b>			
Only one option from Items 3.1 through 3.8 may be selected in this category. Item 3.9 may be taken with Items 3.1 or 3.3 <sup>c</sup> only.			
3.1 <sup>a</sup>	<p>For a System Type 1 in Table R406.2: Energy Star rated (U.S. North) Gas or propane furnace with minimum AFUE of 95%</p> <p>or</p> <p>Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	1.0	1.0
3.2 <sup>a</sup>	<p>For secondary heating system serving System Type 2 in Table R406.2: <del>Air source centrally ducted heat pump with minimum HSPF of 9.5</del> <del>or</del></p> <p>Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	0.5	0.5
3.3 <sup>a,c,d</sup>	<p>Air-source centrally ducted heat pump with minimum HSPF of 9.5.</p> <p>In areas where the winter design temperature as specified in Appendix RC is 23°F or below, a cold climate heat pump found on the NEEP cc ASHP qualified product list shall be used.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	0.5	N/A
3.4 <sup>a,d</sup>	<p>Closed-loop ground source heat pump; with a minimum COP of 3.3</p> <p><b>or</b></p> <p>Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6.</p>	1.5	1.0

	To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.		
3.5 <sup>d</sup>	Ductless mini-split heat pump system, zonal control: In homes where the primary space heating system is zonal electric heating, a ductless mini-split heat pump system with a minimum HSPF of 10.0 shall be installed and provide heating to the largest zone of the housing unit.  To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.	1.5	2.0
3.6 <sup>a</sup>	Air-source, centrally ducted heat pump with minimum HSPF of 11.0.  A centrally ducted air source cold climate variable capacity heat pump (cc VHP) found on the NEEP cc VCHP qualified product list with a minimum of 10 HSPF may be used to satisfy this requirement. In areas where the winter design temperature as specified in Appendix RC is 23°F or below, an air source centrally ducted heat pump shall be a cold climate variable capacity heat pump as listed on the NEEP qualified product list.  To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.	1.0	N/A
3.7 <sup>a,d,e</sup>	Ductless split system heat pumps with no electric resistance heating in the primary living areas. A ductless heat pump system with a minimum HSPF of 10 shall be sized and installed to provide heat to entire dwelling unit at the design outdoor air temperature. <b>Exception:</b> In homes with total heating loads of 24,000 or less using multi-zone mini-split systems with nominal ratings of 24,000 or less, the minimum HSPF to claim this credit shall be 9 HSPF  To qualify to claim this credit, the building permit drawings shall specify the option being selected, the heated floor area calculation, the heating equipment type(s), the minimum equipment efficiency, and total installed heat capacity (by equipment type).	2.0	3.0
3.8 <sup>a,d</sup>	Air-to-water heat pump with minimum COP of 3.2 at 47°F, rated in accordance with AHRI 550/590 by an accredited or certified testing lab. To qualify to claim this credit, the building permit drawings shall specify the option being selected, the heated floor area calculation, the heating equipment type(s), the minimum equipment efficiency, and total installed heat capacity (by equipment type).	1.0	N/A
3.9 <sup>c</sup>	Connected thermostat meeting ENERGY STAR Certified Smart Thermostats/EPA ENERGY STAR specifications. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the thermostat model.	0.5	0.5

**TABLE R406.3 (continued)  
ENERGY CREDITS**

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 <sup>b</sup>
<b>4. HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM OPTIONS</b>			
4.1	<p>HVAC equipment and associated duct system(s) installation shall comply with the requirements of Section R403.3.2.</p> <p>Electric resistance heat, hydronic heating and ductless heat pumps are not permitted under this option.</p> <p>Direct combustion heating equipment with AFUE less than 80% is not permitted under this option.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and shall show the location of the heating and cooling equipment and all the ductwork.</p>	0.5	N/A
<b>5. EFFICIENT WATER HEATING OPTIONS</b>			
Only one option from Items 5.3 through 5.5 may be selected in this category. Item 5.1 and 5.2 may be combined with any option.			
5.1	<p>A drain water heat recovery unit(s) shall be installed, which captures waste water heat from at least two showers, including tub/shower combinations. It is acceptable, but not required, for sink water to be connected. Unit shall have a minimum efficiency of 40% if installed for equal flow or a minimum efficiency of 54% if installed for unequal flow. Such units shall be rated in accordance with CSA B55.1 or IAPMO IGC 346-2017 and be so labeled.</p> <p>To qualify to claim this credit, the building permit drawings shall include a plumbing diagram that specifies the drain water heat recovery units and the plumbing layout needed to install it. Labels or other documentation shall be provided that demonstrates that the unit complies with the standard.</p>	0.5	0.5
5.2	<p>For Compact Hot Water Distribution system credit, the volume shall store not more than 16 ounces of water between the nearest source of heated water and the termination of the fixture supply pipe where calculated using Section R403.5.2. Construction documents shall indicate the ounces of water in piping between the hot water source and the termination of the fixture supply. When the hot water source is the nearest primed plumbing loop or trunk, this must be primed with an On Demand recirculation pump and must run a dedicated ambient return line from the furthest fixture or end of loop to the water heater.</p> <p>To qualify for this credit, the dwelling must have a minimum of 1.5 bathrooms.</p>	0.5	0.5
<u>5.3</u>	<p><u>Water heating system shall include one of the following:</u> <u>Energy Star rated gas or propane water heater with a minimum UEF of 0.80.</u></p> <p><u>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.</u></p>	<u>0.5</u>	<u>0.5</u>



<p><u>5.3-5.4</u></p>	<p><b>Water heating system shall include one of the following:</b>  <u>Energy Star rated gas or propane water heater with a minimum UEF of 0.91</u>  <b>or</b>  Solar water heating supplementing a minimum standard water heater. Solar water heating will provide a rated minimum savings of 85 therms or 2000 kWh based on the Solar Rating and Certification Corporation (SRCC) Annual Performance of OG-300 Certified Solar Water Heating Systems  <b>or</b>  Water heater heated by ground source heat pump meeting the requirements of Option 3.3.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.</p>	<p>1.0</p>	<p>1.0</p>
<p><u>5.4-5.5</u></p>	<p>Water heating system shall include one of the following:  Electric heat pump water heater meeting the standards for Tier III of NEEA's advanced water heating specification  <b>or</b>  For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.</p>	<p>2.0</p>	<p>2.5</p>

**TABLE R406.3 (continued)  
ENERGY CREDITS**

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 <sup>b</sup>
<del>5.5</del> 5.6	<p>Water heating system shall include one of the following: Electric heat pump water heater with a minimum UEF of 2.9 and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors. Equipment shall meet Section 4, requirements for all units, of the NEEA standard Advanced Water Heating Specification with the UEF noted above</p> <p><b>or</b></p> <p>For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.</p>	2.5	3.0
<b>6. RENEWABLE ELECTRIC ENERGY OPTION</b>			
6.1	<p>For each 600 kWh of electrical generation per housing unit provided annually by on-site wind or solar equipment a 0.5 credit shall be allowed, up to 4.5 credits. Generation shall be calculated as follows:</p> <p>For solar electric systems, the design shall be demonstrated to meet this requirement using the National Renewable Energy Laboratory calculator PVWATTS or approved alternate by the code official. Documentation noting solar access shall be included on the plans.</p> <p>For wind generation projects designs shall document annual power generation based on the following factors: The wind turbine power curve; average annual wind speed at the site; frequency distribution of the wind speed at the site and height of the tower.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the photovoltaic or wind turbine equipment type, provide documentation of solar and wind access, and include a calculation of the minimum annual energy power production.</p>	0.5-4.5	0.5-4.5
<b>7. APPLIANCE PACKAGE OPTION</b>			
7.1	<p>All of the following appliances shall be new and installed in the dwelling unit and shall meet the following standards:</p> <ol style="list-style-type: none"> <li>1. Dishwasher, standard – Energy Star rated, Most Efficient 2021 or Dishwasher, compact – Energy Star rated (Version 6.0)</li> <li>2. Refrigerator (if provided) – Energy Star rated (Version 5.1)</li> <li>3. Washing machine (Residential) – Energy Star rated (Version 8.1)</li> <li>4. Dryer – Energy Star rated, Most Efficient 2022</li> </ol> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the appliance type and provide documentation of Energy Star compliance. At the time of inspection, all appliances shall be installed and connected to utilities. Dryer ducts and exterior dryer vent caps are not permitted to be installed in the dwelling unit.</p>	0.5	1.5

a. An alternative heating source sized at a maximum of 0.5 Watts/ft<sup>2</sup> (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.

b. See Section R401.1 and residential building in Section R202 for Group R-2 scope.

- c. Option 3.9 can only be taken with Options 3.1 and 3.3. To qualify to claim Option 3.8 with 3.3, the system shall be a 1-2 speed heat pump system. Variable capacity heat pumps are ineligible from claiming this option.
- d. This option may only be claimed if serving System Type 4 or 5 from Table R406.2.
- e. Primary living areas include living, dining, kitchen, family rooms, and similar areas.

Purpose of code change:

**June 2023 Update: This revised proposal updates the R406 table within the passed CR103, but augments fuel normalization credits, credit targets, and option credit values assuming the removal of the heat pump space and water heating mandates within Section R403. This revised R406 section, matches Ecotope’s original proposal before it was altered through the TAG process to pickup necessary changes for heat pump mandates. This current R406 section is the same approach that has been used for the last 3 code cycles.**

**Energy Equalization consistent with RCW 1927a.160. The efficiency difference of minimally compliant heating equipment is taken into account (Table R406.2) so that the relative site energy use can be accounted. As options from table R406.3 are developed for compliance with this section**

**Incremental Improvements in Energy Efficiency consistent with RCW 19.27a.160.** This proposal is designed to meet the high-level goal of RCW 19.27a.160. This 2021 Section R406 code change proposal is expected to lead a 10% energy reduction over a 2006 WSEC compliant home. These savings are primarily attributed to the credits required to comply with code in Section R406.3, along with prescriptive envelope upgrades.

Your amendment must meet one of the following criteria. Select at least one:

- Addresses a critical life/safety need.
- Consistency with state or federal regulations.
- The amendment clarifies the intent or application of the code.
- Addresses a unique character of the state.
- Addresses a specific state policy or statute.  
(Note that energy conservation is a state policy)
- Corrects errors and omissions.

Check the building types that would be impacted by your code change:

- Single family/duplex/townhome
- Multi-family 4 + stories
- Institutional
- Multi-family 1 – 3 stories
- Commercial / Retail
- Industrial

Your name Henry Odum, PE

Email address henry@ecotope.com

Your organization Ecotope, Inc.

Phone number (206) 596-4715

Other contact name David Baylon

### **Economic Impact Data Sheet**

**Is there an economic impact:**  Yes  No

Briefly summarize your proposal’s primary economic impacts and benefits to building owners, tenants, and businesses. If you answered “No” above, explain your reasoning.

## First cost and energy savings

First cost and energy savings estimates have been developed using an estimating procedure used by the Northwest Power and Conservation Council (NPCC). This method uses 6 prototype single family homes and one multi-family building to assess regional energy impacts. This includes: a 1344 sf rambler (crawl space and slab), a 2200 square foot rambler (crawl space and slab), a 2866 sf home with half basement, a 5000 sf home with a full basement, and a multifamily dwelling units (modeled a 2 story, exterior entry, low-rise building and a 3-story double loaded corridor). For each building both cost and energy savings are estimated for each prototype and each measure.

**First Cost:** The first cost included in Tables 1 and 2 were developed using multiple sources of information:

- NPCC, the Regional Technical Forum (RTF), <http://rtf.nwcouncil.org/> This is a federally mandated multi-state compact that develops the efficiency resources for the region's electric utilities
- Navigant is a business consulting firm which provides resource planning for both gas and electric utilities, including gas utilities in Washington State. <http://www.navigant.com/industries/energy/>
- CEE is the Consortium for Energy Efficiency. CEE is the US and Canadian consortium of gas and electric efficiency program administrators. <http://www.cee1.org/>
- This study also uses cost information provided to the SBCC by Ecotope.
- Inflation has been accounted for on any cost estimates sourced from previous years

The cost of each option will be included in final draft. Cost are considered for 6 single family and 1 multi-family prototype. For single family prototypes, the crawlspace and slab variations have already been incorporated in the '1344sf' and 2200sf' prototypes – which is why only 4 cost numbers will be shown.

## Energy Savings Estimates

***All data shown below was developed during the original 2022 code development process but kept here for reference.***

The energy savings estimates will be included in final draft. They are being developed using 6 single family and one multi-family prototype. For each building prototype, each predominant HVAC system (gas furnace, gas furnace with AC, central heat pump and Ductless heat pumps with zonal electric) is modeled and located in various weather climates within the state. The energy savings attributed to each option are then weighted to consolidate energy savings estimates for the 4 primary categories of homes in Section R406.3 (small, medium, large, and R-2 dwelling units). Large homes (greater than 5000sf) only compromise 2% of the total building stock – therefore energy savings estimates used for the Life Cycle Cost Analysis will be omitted from this economic analysis.

Provide your best estimate of the **construction cost** (or cost savings) of your code change proposal?

**Table 1: Total Measure Costs by Single Family Prototypes**

Option-Description	Gas Credit Value	HP Credit Value	Weighted Measure Cost	Prototypes Weight % by Floor Area			
				1344	2200	2688	5000
				15%	72%	11%	2%
1.1 - U-.24 Glaze	0.5	0.5	\$ 1,730	\$ 991	\$ 1,790	\$ 1,987	\$ 3,688
1.2 - U-.20 Glaze	1	1	\$ 2,537	\$ 1,454	\$ 2,625	\$ 2,914	\$ 5,409
1.3 - 5% UA reduc	0.5	0.5	\$ 1,261	\$ 955	\$ 1,270	\$ 1,762	\$ 476
1.4 - 15% UA reduc	1	1	\$ 3,263	\$ 1,925	\$ 3,255	\$ 4,676	\$ 5,802
1.5 - 22.5% UA reduc	2	1.5	\$ 4,721	\$ 2,938	\$ 4,850	\$ 5,735	\$ 7,852
1.6 - 30% UA reduc	3	2.5	\$ 11,235	\$ 6,819	\$ 12,095	\$ 10,587	\$ 16,991
2.1 - 2 ACH, HRV	1	0.5	\$ 2,264	\$ 1,395	\$ 2,284	\$ 2,790	\$ 5,190
2.2 - 1.5 ACH, HRV	1.5	1	\$ 5,411	\$ 3,334	\$ 5,457	\$ 6,667	\$ 12,402
2.3 - 0.6 ACH, HRV	2	1.5	\$ 6,988	\$ 4,306	\$ 7,048	\$ 8,612	\$ 16,019
3.1a - Furnace	1	1	\$ 252	\$ 252	\$ 252	\$ 252	\$ 252
3.2a - 9.5 HSPF HP	0.5	0.5	\$ 1,388	\$ 1,388	\$ 1,388	\$ 1,388	\$ 1,388
3.3a - GSHP	1.5	1.5	\$ 11,034	\$ 10,900	\$ 10,900	\$ 10,900	\$ 17,600
3.4 - DHP	1.5	1.5	\$ 1,530	\$ 1,530	\$ 1,530	\$ 1,530	\$ 1,530
3.5a - 11.0 HSPF HP	1	1	\$ 1,530	\$ 1,530	\$ 1,530	\$ 1,530	\$ 1,530
3.6a - DHP (15% elec)	2	2	\$ 5,901	\$ 5,901	\$ 5,901	\$ 5,901	\$ 5,901
4.1 - Deeply buried	1	0.5	\$ -	\$ -	\$ -	\$ -	\$ -
4.2 - HVAC inside	1.5	1	\$ 328	\$ 328	\$ 328	\$ 328	\$ 328
5.1 - DWR	0.5	0.5	\$ 437	\$ 437	\$ 437	\$ 437	\$ 437
5.2 - 0.80 gas DHW	0.5	0.5	\$ 640	\$ 640	\$ 640	\$ 640	\$ 640
5.3 - 0.91 gas DHW, GSHP	1	1	\$ 1,009	\$ 1,009	\$ 1,009	\$ 1,009	\$ 1,009
5.4 - Tier III HPWH	2	2	\$ 955	\$ 955	\$ 955	\$ 955	\$ 955
5.5 - CO2 HPWH	2.5	2.5	\$ 3,824	\$ 3,824	\$ 3,824	\$ 3,824	\$ 3,824
6.1 - Solar pV	1	1	\$ 5,040	\$ 5,040	\$ 5,040	\$ 5,040	\$ 5,040
7.1 - ES Appl+ventless Dryer	0.5	0.5	\$ 505	\$ 505	\$ 505	\$ 505	\$ 505

**Table 2: Total Measure Costs for Multifamily prototype**

Option-Description	Credit Value	Measure Cost
1.1 - U-.24 Glaze	0.5	---
1.2 - U-.20 Glaze	1	\$ 887
1.3 - 5% UA reduc	---	\$ 173
1.4 - 15% UA reduc	1	\$ 947
1.5 - 22.5% UA reduc	1.5	\$ 1,383
1.6 - 30% UA reduc	2	\$ 3,779
2.1 - 2 ACH, HRV	0.5	\$ 851
2.2 - 1.5 ACH, HRV	1	\$ 2,034
2.3 - 0.6 ACH, HRV	1.5	\$ 2,627
3.1a - Furnace	1	\$ 252
3.2a - 9.5 HSPF HP	---	---
3.3a - GSHP	1	---
3.4 - DHP	2	\$ 3,060
3.5a - 11.0 HSPF HP	---	\$ -
3.6a - DHP (15% elec)	3	\$ 5,245
4.1 - Deeply buried	0.5	\$ -
4.2 - HVAC inside	---	---
5.1 - DWR	---	\$ 505
5.2 - 0.80 gas DHW	0.5	---
5.3 - 0.91 gas DHW, GSHP	1	---
5.4 - Tier III HPWH	2.5	\$ 318
5.5 - CO2 HPWH	3	\$ 1,275
6.1 - Solar pV	1	\$ 5,040
7.1 - ES Appl+ventless Dryer	1.5	\$ 505

Provide your best estimate of the **annual energy savings** (or additional energy use) for your code change proposal?

**See Table 3 for kWh/dwelling unit or therm/dwelling unit savings (savings values are positive)**

#### Energy Savings Estimates

The energy savings estimates below have been developed using 6 single family and two multi-family prototypes. For each building prototype, each predominant HVAC system (gas furnace, gas furnace with AC, central heat pump and Ductless heat pumps with zonal electric) was modeled and located in various weather climates within the state. The energy savings attributed to each option listed in Table 406.3 were then weighted to consolidate energy savings estimates for the 4 primary categories of homes in Section R406.3 (small, medium, large, and R-2 dwelling units). As shown in Table 1, large homes (greater than 5000sf) only compromise 2% of the total building stock – therefore energy savings estimates used for the Life Cycle Cost Analysis have been omitted from this economic analysis.

**Table 3: Savings All Climates, All Systems**

	S				M				MF
	gfac	gfac	ashp	zonl	gfac	gfac	ashp	zonl	zonl
<b>Options Table 2021</b>	kWh	Therm	kWh	kWh	kWh	Therm	kWh	kWh	kWh
mandatory req's	0	0	0	0	0	0	0	0	0
windows U=0.24	114	5	1143	173	292	5	302	348	132
windows U=0.2	160	12	1192	291	369	18	492	597	263
envelope 3 - 5% UA	18	0	1101	94	-70	-2	59	122	-34
envelope 4 - 15% UA	151	24	1243	406	288	28	528	648	223
envelope 5 - 22.5% UA	303	33	1315	581	577	41	817	1015	420
envelope 6 - 30%UA	348	55	1430	821	887	69	1158	1456	555
air leakage 1 hrv	-116	3	1059	-10	-271	19	105	111	329
air leakage 2 hrv	4	45	283	344	87	67	504	664	642
air leakage 3 hrv	91	54	414	487	530	78	762	997	934
AFUE .95	-84	34	-	-	55	51	-	-	
HSPF 9.5	-	-	248	-	-	-	328	-	
DHP HSPF 10(zonal only)	-	-	-	689	-	-	-	1129	-41
HSPF 11	-	-	371	-	-	-	980	-	
DHP HSPF 10 whole house (zonal only)	-	-	-	1154	-	-	-	2185	740
ducts inside	356	32	385	-	781	38	666	-	
drain water heat recovery	76	23	260	247	-55	33	282	318	182
dwh gas UEF 0.80	18	27	-	-	3	34	-	-	
dwh gas UEF 0.91	-28	39	-	-	12	48	-	-	
hpwh Tier III	-930	121	1407	1395	-1167	153	1761	1790	973
UEF 2.9	-813	121	1536	1512	-1099	156	1916	1941	1055
Energy Star appliances	722		824	784	625		750	776	629

**Table 4: Measure cost estimates (\$/component area, SF or housing unit)**

Component	Base Level	Measures Beyond Base Level	Cost (2021) \$s \$/ft2 or \$/unit	Source
<b>Envelope</b>				
Ceiling	R-60	R-60 RH Ceiling Insulation	\$ 0.22	CERF
Ceiling	R-60	R-49 Advanced	\$ 0.25	CERF
Wall	R-13 int Wall + R10 Foam Sheathing	R-21 int Wall + R12 Foam Sheathing	\$ 1.05	6th plan
Wall	R-13 int Wall + R10 Foam Sheathing	R-21 int Wall + R-4 Foam Sheathing	\$ 2.46	6th plan
Wall	R-13 int Wall + R10 Foam Sheathing	R-21 int Wall + R16 Foam Sheathing	\$ 3.28	6th plan
Floor	R-30	R-38 Floor	\$ 0.42	RTF-ResNCMTHouseID_v_3_0 .xlsx April 4, 2018; ShellCosts tab
Slab	R-10 4' perim	Slab R-15 4' perim	\$ 0.99	6th Plan Appendix G
Slab	R-10 4' perim	Slab R-10 Full	\$ 0.99	6th Plan Appendix G
Slab	R-10 4' perim	Slab R-20 Full	\$ 1.33	6th Plan Appendix G
Window	U-0.30	Window U-0.25	\$ 4.92	NPCC Standard workbook
Window	U-0.30	Window U-0.24	\$ 4.92	NPCC Standard workbook
Window	U-0.30	Window U-0.22	\$ 7.21	NPCC Standard workbook
Window	U-0.30	Window U-0.20	\$ 7.21	NPCC Standard workbook
Window	U-0.30	Window U-0.18	\$ 9.83	MF bids (tripleglaze-BidPrices.xl) Costs from ecowindows bids are about 26.50/sf or 8.50 incremental with contractor mark-up
<b>Air Sealing &amp; Ventilation</b>				
ACH	Tested Infiltration at 3 ACH 50	Tested Infiltration to 2 ACH50	\$ 0.22	RTF Workbook. ResWXS_FY10v2_1.xls, at \$.18/ft^2 per 1ACH50 reduction. Dan W
ACH	Tested Infiltration at 3 ACH 50	Tested Infiltration to 1.5 ACH50	\$ 0.30	
ACH	Tested Infiltration at 3 ACH 50	Tested Infiltration to 0.6 ACH50	\$ 0.47	
Exhaust Fan	Pt Source Exhaust Fan =0.75W/cfm	Pt Source Exhaust Fan <0.35W/cfm	\$ 88.12	navigant 2013
ERV	No ERV	ERV with SHR>= 0.65	\$ 0.82	\$400 for WhisperComfort and \$400 for ducting
ERV	No ERV	ERV with SHR>= 0.75	\$ 2.19	renewaire or lifebreath
ERV	No ERV	ERV with SHR>= 0.80	\$ 2.73	high efficiency HRV with ducting (venmar, zhender)
<b>HVAC System</b>				
Ducts	Code level is sealed	Ducts Inside	\$ 327.81	NPCC Sixth Power Plan, Support documentation
Furnace	0.8	Furnace Upgrade to 94AFUE	\$ 251.59	Navigant Sept 2011 Report for NEEP
Heat Pump	8.2 HSPF	9.5 HSPF	\$ 1,387.73	SIW, linear regression from 9 HSPF pricing
DHP	Zonal Resistance	1-ton single zone DHP	\$ 3,059.56	Ecotope analysis of NEEA DHP pilot program database
11.0 DHP	8.2 DHP	1-ton single zone DHP	\$ 1,529.78	Ecotope analysis of NEEA DHP pilot program database
Heat Pump	8.2 HSPF	11 HSPF	\$ 5,900.58	3 ton unit. ResSFExistingHVAC
multizone 11.0 DHP	8.2 HSPF	10 HSPF efficiency with no electric resistance. Reduction in elec heat but higher tonnage	\$ 5,900.58	Ecotope analysis of NEEA DHP pilot program database
<b>Domestic Hot Water</b>				
Water Htr	0.59 EF	Gas Water Heater >=0.80 EF	\$ 640.32	NREL, 2013
Water Htr	0.59 EF	Gas Water Heater >=0.91 EF	\$ 1,008.56	NREL, 2013
Water Htr	0.95 EF	Heat Pump Water Heater 2 EF	\$ 955.02	RTF ResHPWH.xls
DWHR	none	Drain water heat recovery pipe	\$ 437.08	RTF RESDHWDrainWaste.xls
Water Htr	0.95 EF	Tier 3 Water Heater 3 EF	\$ 955.02	RTF ResHPWH.xls
Water Htr	0.95 EF	CO2 Water Heater 4 EF	\$ 3,824.45	RTF ResHPWH.xls
<b>Appliances</b>				
Dryers, refr, dishwasher	Fed pre-empted	Heat pump dryers, ES appliances	\$ 504.83	RTF-ResClothesDryers, ResRef, HD.com \$420 for HP dryer, +\$40 for Cloth washer, +\$90 for refr

List any **code enforcement** time for additional plan review or inspections that your proposal will require, in hours per permit application: No expected additional plan review. Structure of table is the same as previous code cycles



**Housing Affordability.** Describe economic impacts on housing affordability: Small homes are required to have fewer efficiency credits than larger homes. This is consistent with previous code cycles.